Harnessing Behavioral Science to Design Disposable Bag Regulations

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Abstract

Regulation of single-use plastic products is at the center of much policy debate. Currently, there are over 400 laws in the US aimed at curbing disposable shopping bag use. Some regulators opt for command-and-control policies that ban disposable plastic bags, while others use market-based incentives like taxes on disposable bags or rewards for reusable bag use—choices that may greatly impact the policy's effectiveness. In this paper, we review the evidence on the effectiveness of these policy design choices through a behavioral economics lens and highlight best practices for policymakers considering similar legislation.

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I. Why Regulate Disposable Bags?

Each year Americans consume 100 billion single-use plastic bags (Clapp and Swanston, 2009; Wagner, 2017). When not disposed in landfills, plastic bags clog storm drains, seep into waterways, and hang on trees, costing local governments between $3 and $8 billion per year to clean up (Taylor and Villas-Boas, 2016). In addition to clean-up costs, plastic bags pose environmental costs beyond the jurisdictional borders. (Jambeck et al., 2015) calculate that 2–5% of plastic waste is mismanaged and enters the ocean. Once in waterways, plastic bags do not biodegrade but, instead, break into smaller pieces, which sea animals can consume while mistaking them for food (Wilcox et al., 2016). Disposable paper bags, a common substitute for single-use plastic bags, are not without their own environmental costs. These bags have fewer costs associated with disposal, but are more environmentally-costly to produce and transport than plastic bags. The UK Environmental Agency (2011) estimates that the life-cycle environmental impacts of paper bags, in terms of carbon footprint, are four times as large as those of lightweight plastic bags.

Economic principles provide a strong rationale for intervening in the market for disposable bags. When markets fail to allocate goods efficiently, economists generally support government intervention. Free markets—where governments impose few regulations on individuals and businesses—are only economically efficient when there are no market failures. The case for regulation of disposable bags is largely motivated by the presence of environmental externalities, i.e., the use of disposable bags imposes costs on the environment which are not reflected in the price of bags. For example, disposable plastic bags cost US retailers 3 cents each on average (Taylor and Villas-Boas, 2016), while cities in the US spend between 3 and 8 cents per plastic bag on litter control alone (Burnett, 2013). Additionally, the way in which customers are charged for disposable bags exacerbates the externality problem: stores usually roll the cost of bags into the overall price of groceries, as they do with the cost of the store's air conditioning or the cashiers' salaries, rather than charging for each bag. Thus, instead of choosing the number of bags desired based on price, customers perceive the receipt of disposable bags to be free, which leads customers to use more bags than they would if paying for each bag individually (Shampanier, Mazar and Ariely, 2007). This may be exacerbated if cashiers prioritize time efficiency over minimizing bag use.

Standard economic principles suggest successful disposable bag policies should address these

Table 1: Types of Disposable Bag Policies

Market-Based Incentives		**Command-and-Control**	
Disposable Bag Taxes	Reusable Bag Bonus	Stand-alone Bans	Hybrid Bans
			
Small tax/fee per disposable carryout bag used by customers; issued at point of sale	Small bonus given to customers by retailers for using reusable bags at checkout	Prohibits use of plastic carryout bags under a certain thickness (generally 2.25 mils thick) at checkout	Prohibits use of plastic carryout bags under a certain thickness and requires all remaining carryout bags are sold at a minimum price
Examples: • Denmark (1994) • Ireland (2002) • South Africa (2004) • Washington, DC (2010) • Boulder, CO (2013) • Israel (2017) • Spain (2018) • Peru (2019)	• Kroger • Safeway • Giant • Target • Whole Foods • Trader Joe's • Ralphs	• Bangladesh (2002) • San Francisco, CA (2007; replaced with hybrid ban in 2012) • Chicago, IL (2015; replaced with tax in 2017) • Kenya (2017) • New York (2020; hybrid ban opt-in)	• Seattle, WA (2012) • California (2016) • Boston, MA (2017) • Minneapolis, MN (2017) • Oregon (2020) • Vermont (2020)

market failures. And moreover, successful policies need to consider how customers respond to policy interventions and what behavioral biases, or tendencies, customers have (Jia, Evans and van der Linden, 2019). This is where behavioral economics plays an important role. Behavioral economics studies the effects of psychological, emotional, and social factors on economic decision-making. This paper brings together principles from standard economics and behavioral science to assess recent regulations of the use of disposable bags.

II. Policy Background

Governments around the world have implemented a variety of policies to regulate the use of disposable bags to address their costs to the environment and to government budgets. While these policies share the common goal of reducing waste, in practice they can be divided into two approaches: (1) market-based approaches that financially incentivize consumers to change their behavior; and (2) command-and-control approaches that regulate consumer behavior directly. Table 1 summarizes the most commonly used disposable bag policies.

A. Market-Based Incentives

Market-based incentives to discourage disposable bag use typically take the form of a small fee or tax, charged per disposable bag used by customers at checkout. One of the more well-known examples is the Irish "Plastax", a €0.15 tax on all plastic shopping bags (Convery, McDonnell and Ferreira, 2007). In 2010, Washington, D.C. became the first city in the US to adopt a similar policy which placed a five-cent tax on all disposable bags provided by grocery retailers (Homonoff, 2018). In addition to government regulations, many retailers have proactively adopted their own policies to curb the use of disposable shopping bags. One common policy offers customers a reusable bag credit—usually between 3 and 5 cents—for each reusable bag the customer uses instead of taking a disposable bag.[1]

B. Command-and-Control Policies

Alternative to market-based approaches, command-and-control policies set standards for allowable products or actions, banning all those that do not meet the standards. In our setting, these policies typically take the form of a ban on lightweight plastic shopping bags. In 2002, Bangladesh became the first country to ban the use of plastic bags. Five years later, San Francisco became the first jurisdiction in the US to pass a similar law which prohibited the provision of plastic bags less than 2.25 mils thick, roughly the thickness of a commercial garbage bag. Currently, bans on plastic bags are the most common disposable bag regulation worldwide (Nielsen, Holmberg and Stripple, 2019) and over 90 percent of state and local ordinances in the US that regulate disposable bag provision incorporate a ban on plastic bags (Homonoff et al., 2020). These policies take two forms. "Stand-alone bans" restrict the use of traditional plastic shopping bags, often using a similar thickness cutoff as in San Francisco's policy, but leave other types of disposable bags—such as paper bags—unregulated. "Hybrid bans" pair bans on lightweight plastic bags with a minimum required fee for paper and reusable bags (usually between five and 10 cents).

[1] These policies have been implemented by some of the largest grocery chains in the US, including Kroger, Safeway, Giant, Target, and Whole Foods.

III. Policy Lessons and Insights from Behavioral Science

This section provides policy design recommendations, founded in both standard and behavioral economics, for governments and policymakers interested in implementing disposable bag regulations. To inform these recommendations, we begin with a review of recent evidence on the effectiveness of various disposable bag regulations. We focus on evaluations employing a "difference-in-differences" methodology, i.e., those that compare bag use before and after a policy change, and among customers shopping in areas affected by the regulation (treatment areas) and those shopping in unregulated areas (control areas).[2]

Lesson 1: Disposable Bag Taxes Work Better than Reusable Bag Bonuses (i.e., Sticks over Carrots)

Market-based incentives can take the form of subsidies for environmentally-friendly behavior (i.e., carrots) or financial penalties for environmentally-costly behavior (i.e., sticks). In the context of disposable bag regulations, policymakers may consider a bonus for reusable bag use or a tax on disposable bag use. Standard economic models suggest that the choice between these two policy designs—taxes versus bonuses—should not matter as long as the incentives are the same amount. However, if customers are loss-averse (Kahneman and Tversky, 1979), meaning that they experience losses more strongly than similar-sized gains, a tax may be more effective than a bonus of the same magnitude. Empirical evidence of loss aversion in the field has been documented in several contexts including among stock market investors (Benartzi and Thaler, 1995), taxi cab drivers (Camerer et al., 1997), and professional golfers (Pope and Schweitzer, 2011). In this section we first review evaluations of policies that levy small taxes on disposable bag use and then compare those findings to estimates of the effect of similar sized bonuses for reusable bag use.

In one of the first evaluations of disposable bag taxes in the US, Homonoff (2018) estimates the effect of the implementation of a five-cent tax on disposable bags in Montgomery County, Maryland. This study uses observational data on disposable and reusable bag use in the months just before

[2] A large body of empirical research evaluates these regulations using a "simple difference" approach, i.e., comparing consumer behavior before and after a policy change. Rivers, Shenstone-Harris and Young (2017) provides a review of these studies, but highlights that this approach may lead to biased estimates since it does not account for confounding events that may occur simultaneously with the policy change. To our knowledge, there have been no randomized control trials conducted in this policy area, and so the difference-in-differences research design provides the most credible causal identification strategy used to evaluate disposable bag regulations.

and just after the tax was implemented at stores in Maryland (which experienced a policy change), Washington, D.C. (which had a five-cent tax throughout the study period), and in Virginia (which had proposed a tax, but never passed one). The study finds that prior to the tax, just over 80 percent of customers used a disposable bag and that the tax decreased the proportion of customers using a disposable bag by 42 percentage points.[3] Homonoff et al. (2020) also estimate a large effect of the implementation of a 7-cent tax in Chicago—a decrease in disposable bag use of 33 percentage points.

Similar evaluations of disposable bag charges have been conducted in several other countries as well. Using observational customer data, Jakovcevic et al. (2014) finds that the implementation of a 2.5 to 4 cent tax on disposable bags in the city of Buenos Aires led to increases in the proportion of customers using a reusable bag relative to behavior in Greater Buenos Aires (which was not subject to the tax) that are similar in magnitude to those estimated in the US studies. Cabrera, Caffera and Cid (2020) use administrative data on disposable bag use from retailers and the staggered roll-out of a 7-10 cent tax in Uruguay and find a roughly 80 percent decrease in the number of bags provided. Rivers, Shenstone-Harris and Young (2017) and Poortinga et al. (2016) evaluate the effect of a 5-cent bag levy in Toronto and a 5p carrier bag charge in Wales, respectively, using survey data on reusable bag use. Both studies find statistically significant increases in reusable bag use; however, the magnitude of these estimates are considerably smaller than those estimated in the US and Latin American evaluations.[4]

One interpretation of the large change in consumer behavior after the implementation of relatively small taxes, as described above, is that there are many customers just on the margin of bringing a reusable bag instead of taking a disposable bag. In other words, the cost a customer associates with bringing a reusable bag is no more than five cents per bag—otherwise the customers would continue to take disposable bags at the same rate that they always had. If this is the case, a similar-sized bonus for reusable bag use should be equally effective. If, instead, the behavioral change is driven by loss-averse customers who are reacting to the pain of paying the tax, but do not otherwise care about seeing their wealth change by a nickel, the bonus may not be as effective.

[3] Taylor (2020) finds similar results using scanner data from a large supermarket chain in the D.C. metropolitan area, with only 35 percent of D.C. customers paying the bag tax a year after the policy was enacted.

[4] These differences may be due to the higher baseline levels of reusable bag use observed in Toronto and Wales, differences in data (observational data versus self-reported surveys), or other regional differences in response to the policy.

In addition to estimating the effect of the five-cent tax, Homonoff (2018) compares disposable bag use at retailers in the D.C. area that offered a five-cent reusable bag bonus to those that did not and found no differences in disposable bag use. These findings are supported by anecdotal evidence from retailers that the reusable bag credits showed little effect on reusable bag use, resulting in many retailers rolling back these incentives Sewell (2011). This asymmetry in customer responses to the two types of policies—a large change in behavior with a five-cent tax, but no change in behavior in response to a five-cent bonus—is consistent with a model of loss aversion and suggests that policymakers considering market-based incentives to discourage disposable bag use should use sticks rather than carrots.

Lesson 2: A Bag Tax Does Not Have to Be Large to Be Effective

Proponents of disposable bag taxes have hotly debated the ideal size of the tax. Early failed disposable bag legislation in California suggested a 2-cent fee on all plastic bags as part of the "Litter and Marine Debris Reduction and Recycling Act" of 2003 (Romer, 2010). Two years later, San Francisco proposed a 17-cent fee on both plastic and paper bags but the proposal was met with public opposition causing policymakers to consider lower fee rates (Herel, 2005). In 2008, Seattle became the first city in the US to pass a disposable bag fee—a 20-cent fee on both plastic and paper bags—but before the fee was implemented, the policy was placed on a citywide ballot and voted down. Three years later, however, the city successfully implemented a policy that banned plastic bags and charged a 5-cent fee for paper bags. This suggests that policymakers face a trade-off when choosing the size of the fee: higher fees may generate larger reductions in waste, but are less likely to receive enough political support to be implemented at all.

To date, there remains limited evidence on the effect of this dimension of the policy's design—the magnitude of the fee—primarily because the majority of disposable bag fees in the US are between five and 10 cents, though a few jurisdictions levy fees as high as 25 cents per bag. Nevertheless, the evidence described above suggests that even very small taxes on disposable bags lead to large changes in behavior across a wide range of countries. While these findings do not rule out standard models of economic decision-making, especially if the cost of avoiding a disposable bag is very small, Shampanier, Mazar and Ariely (2007) suggests that individuals do not apply standard cost-benefit rules when making purchasing choices over two goods when one of the goods is free. They suggest

that receiving a good for free not only decreases its cost, but also increases its benefits, i.e., people really like getting things for free. This implies that a very small fee—even one or two cents per bag—may lead to large decreases in disposable bag use since the bags are no longer free.

There are several other behavioral mechanisms that may contribute to the disposable bag tax's effectiveness in spite of its small size: (1) salience, (2) habit formation, and (3) social norms.

Salience. A growing literature on "tax salience" demonstrates that if a tax is out of sight—either because of the placement of the tax, payment method, or the complexity of the tax—then it is also out of mind when individuals make economic decisions. For example, Chetty, Looney and Kroft (2009) show that including sales taxes (which are usually added on at the register) in the posted price of a good decrease sales of that good. Similarly, Finkelstein (2009) shows that reducing the salience of road tolls through the introduction of EZ-Pass reduced the responsiveness of drivers to changes in the toll. Conversely, there are several examples in the field of environmental economics that suggest that taxes are more salient than traditional price changes. For example, Li, Linn and Muehlegger (2014) show that customers responded more to an increase in a gasoline tax than a similarly sized increase in gas prices driven by oil price changes, citing that media coverage of the tax made it more salient. Similarly, Rivers and Schaufele (2015) find that the introduction of a carbon tax in Canada led to a significantly larger change in the demand for gasoline than an equivalent price change using variation in policies across provinces. Consistent with these findings, Homonoff (2018) finds near-perfect awareness of the D.C. area disposable bag taxes, suggesting that salience may have contributed to the policy's effectiveness.

Habit Formation. One reason customers may use disposable bags is because they are simply in the habit of doing so, especially when being provided a bag is the default. In other words, the decision to use a disposable bag may not be a deliberate choice for consumers; they are likely not actively weighing the costs and benefits of each bag for each purchase, but rather acting on autopilot and making decisions based on the choices they made in the past. When a disposable bag tax is introduced, it cues customers to make an active choice of whether to pay for a disposable bag (Neal, Wood and Quinn, 2006). This choice, when repeated over time, can then serve as the foundation for a new habit. Taylor (2020) finds evidence of habit formation after the implementation of taxes and hybrid bans—with the share of customers paying for disposable bags fluctuating only in the first two weeks of the policies and then remaining constant for the next 1 to 2 years of the sample

period.

Social Norms. Behavioral science research has shown that social comparison can be a powerful policy tool, especially in the area of environmental conservation (Goldstein, Cialdini and Griskevicius, 2008; Allcott, 2011). Since reusable bag use is a highly visible behavior, even a small initial impact of the tax can generate large effects through a social multiplier (Benabou and Tirole, 2011). Separately, these policies may be particularly effective when they are government regulations rather than, say, store policies, due to the "expressive function of law," a legal theory that suggests that passing a law signals a change in social norms by stating which behaviors warrant punishment (Cooter, 1998).

It is worth pointing out that the change in consumer behavior in response to disposable bag taxes is much larger than responses to similar-sized taxes on other products like soda (Falbe et al., 2016; Taylor, 2019). This may suggest that demand for disposable bags is simply more elastic, however, elements of the decision-making environment described above that are unique to the case of disposable bags—the salience of the tax, habit formation, and the fact that disposable bags were originally considered "free"—may contribute to the effectiveness of disposable bag taxes. While more research is necessary to determine the relative contribution of each of these components of the choice environment, each of these factors likely had a hand in the overwhelming effectiveness of disposable bag taxes across a wide variety of countries.

Lesson 3: Plastic Bag Bans Can Lead to Unintended Consequences (i.e., Avoid the Cobra Effect)

The policies described above all aim to reduce the environmental costs associated with single-use shopping bags. However, certain policy designs may lead to unintended consequences, i.e., outcomes that are not anticipated and may run counter to the policy's stated goal. This latter outcome, when the policy solution exacerbates the problem, is often referred to as the "Cobra Effect," a term derived from a cautionary tale in which a policy aimed at reducing the number of cobras by offering a reward for each captured snake led to an increase in cobra breeders (Heath, 2020). In the context of disposable bag regulation, how plastic bags are regulated will affect the use of substitutes for plastic bags, which, depending on the environmental cost of the substitute, could undermine the intended consequences of the policy.

In the case of stand-alone bans, the most common command-and-control policy, research suggests that the cure may be worse than the disease. Homonoff et al. (2020) evaluates the effect of a stand-alone plastic bag ban implemented in the city of Chicago in 2015 and then repealed in 2017. Like San Francisco's policy, the ban applied to plastic bags less than 2.25 mils thick. In response to the ban, and counter to the policy's goal, retailers circumvented the regulation by offering customers free thick plastic bags roughly five times the thickness of the standard plastic grocery bags that were on offer prior to the ban.[5] During the ban, over 40 percent of Chicago customers used a newly-provided thick plastic bag. Using observational data on customer-level disposable bag use for customers shopping in Chicago (which was covered by the ban) and in the surrounding suburbs (which did not impose any disposable bag regulations), this study finds the ban's repeal did not change the proportion of customers using a disposable bag, however, with the repeal, stores reversed the use of thicker plastic bags. These findings suggest that the ban increased the environmental costs associated with disposable bag use by shifting customers towards more environmentally-harmful disposable bags without reducing the overall number of customers using disposable bags.

Hybrid bans present an alternative policy design that restricts the use of plastic bags while leaving fewer disposable substitutes unregulated. Taylor and Villas-Boas (2016) evaluate the effect of such a policy in Richmond, California that combined a ban on lightweight plastic bags with a five-cent minimum fee for all other bags. Using similar data (observational data on customer bag use) and research strategy (comparing bag use before and after a policy change in regulated versus unregulated cities), this study finds that, unlike with the stand-alone ban, the hybrid ban led to a substantial reduction in the use of disposable bags of roughly 35 percentage points.[6]

While estimates of the effect of disposable bag taxes and hybrid bans on disposable bag use are encouraging, they may overestimate the effect on overall environmental costs if customers reuse plastic bags for purposes other than carrying goods. For example, if customers reuse plastic bags as waste bin liners, plastic bag bans might lead to increased purchases of plastic trash bags. Taylor (2019) uses county-time variation in the roll-out of various hybrid bans in the state of California and finds large increases in sales of plastic trash bags—a 120 percent increase for small trash bags

[5] Solomon (2016) provides anecdotal evidence of similar behavior among retailers after the implementation of a stand-alone ban in Honolulu County, Hawaii in 2015. When San Francisco implemented its stand-alone ban, paper bag use increase by more than fourfold (Freinkel, 2011) motivating a shift to a hybrid ban in 2012.

[6] Additionally, the majority of customers used paper bags instead of plastic bags, though customers shopping at a grocery chain that offered 15-cent thick plastic bags used thick plastic and paper bags in roughly equal proportions.

(the closest substitute for thin plastic shopping bags). The study shows that over a quarter of the plastic reduction from the hybrid bans is offset by the increase in purchases of plastic trash bags.

IV. Discussion

In this paper, we lay out several policy design lessons for disposable bag regulations based on behavioral science theory and supported by empirical evidence. Importantly, many of the studies highlighted in this review evaluate policies implemented in OECD countries, with the exception of two Latin American studies, due to our study design decision criteria for inclusion. However, we believe that the lessons we highlight apply to a broader range of geographies than those discussed in this review. In fact, many studies employing a simple difference design also demonstrate large decreases in disposable bag use in response to small penalties and minimal effects of plastic bag bans across a wider range of geographies (Rivers, Shenstone-Harris and Young, 2017; Nielsen, Holmberg and Stripple, 2019).

Two common regulation designs adhere to our policy recommendations: disposable bag taxes and hybrid bans. Both policies have been shown to yield large decreases in disposable bag use. In contrast, the most common policy in the US, a stand-alone plastic bag ban, may simply change the type of disposable bag a customer uses without decreasing overall use and may even cause retailers to offer free thicker plastic bags that generate more waste. Homonoff et al. (2020) directly compares the life-cycle environmental costs associated with disposable bag use under the two disposable bag regulations in Chicago—a stand-alone ban and a disposable bag tax—and finds under the ban (relative to the tax), customers used the environmental cost equivalent of over six additional lightweight plastic bags per shopping trip. Importantly, even small bag taxes have been shown to generate large effects on consumer behavior. As a result, policymakers interested in decreasing disposable bag use who are concerned about the economic burden and regressivity of a tax may want to consider a very small tax rather than no tax at all.

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